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**WHAT IS CLAIMED IS:**

1. An optical flow meter for measuring a flow of fluid through a pipe, the optical flow meter comprising:
  - (a) a wave energy source for generating a pair of beams;
  - 5 (b) a driver for controlling the wave energy source;
  - (c) a modulator coupled to said wave energy source for modulating a phase of one of said pair of beams at a phase modulation frequency;
  - (d) means for directing said pair of beams in opposite directions along a path through the flow of fluid;
  - 10 (e) means for receiving a pair of diffused beams after said pair of beams have crossed said path;
  - (f) a detector for detecting said pair of diffused beams and for producing an electrical signal representative of a phase difference between said pair of diffused beams;
  - 15 (g) a digital signal processor configured to receive said electrical signal and calculate a flow velocity from said phase difference between said pair of diffused beams;
  - (h) a pair of collecting optical systems positioned at opposite ends of said path adjacent to said means for directing said pair of beams for collecting deflected wave energy from said pair of beams; and
  - 20 (i) a compensation module coupled to receive said deflected wave energy from said collecting optical systems, said compensation module configured to estimate a total intensity of wave energy received by said means for receiving said pair of diffused beams and to generate a compensation signal representative of said total intensity of wave energy received, and coupled to provide said compensation signal to said driver,
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whereby said driver controls said wave energy source to vary an initial intensity of said pair of beams in response to said compensation signal such that said total intensity of wave energy received remains constant.

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2. An optical flow meter according to claim 1 wherein said means for directing said pair of beams in opposite directions along a path through the flow of fluid and said means for receiving said pair of diffused beams after said pair of beams have crossed said path comprise a pair of fibers, each of said pair of fibers comprising a tip positioned to direct one of said pair of beams towards a tip of the other of said pair of fibers.
- 10 3. An optical flow meter according to claim 1 wherein at least one of said collecting optical systems comprises a pair of receiving apertures separated by a distance along a direction of said flow of fluid, the optical flow meter further comprising a cross-correlation module coupled to receive signals from said pair of receiving apertures, said cross-correlation module configured to generate an estimated flow velocity based on a cross-correlation function of said signals from said pair of receiving apertures and provide said estimate flow velocity to said digital signal processor.
- 15 20 4. An optical flow meter according to claim 1 wherein said compensation module is configured to provide said compensation signal to said digital signal processor, and wherein said digital signal processor is configured to calculate a refractive index of said flow from said compensation signal and use said refractive index in calculation of said flow velocity.
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5. An optical flow meter according to claim 1 wherein said path through the flow of fluid is at an acute angle to a direction of the flow of fluid.
- 5 6. An optical flow meter according to claim 1 wherein said path through the flow of fluid is parallel to a direction of the flow of fluid.
- 10 7. An optical flow meter according to claim 1 further comprising a polarizer coupled to said wave energy source for polarizing said pair of beams.
- 15 8. An optical flow meter according to claim 2 wherein said wave energy source is configured to produce a second pair of beams, and wherein said pair of fibers comprises a first pair of fibers and said path comprises a first path, further comprising:
  - (a) a second pair of fibers for directing said second pair of beams in opposite directions along a second path through the flow of fluid, each of said second pair of fibers comprising a tip positioned to direct one of said second pair of beams towards a tip of the other of said second pair of fibers and to receive a diffused beam from the tip of the other of said second pair of fibers; and,
  - (b) a second pair of collecting optical systems, each of said second pair of collecting optical systems positioned adjacent to the tip of one of said second pair of fibers for collecting deflected wave energy from said second pair of beams.
- 20 9. An optical flow meter according to claim 8 wherein said first and second paths are generally parallel.
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10. An optical flow meter according to claim 1 wherein said wave energy source comprises a laser.
11. An optical flow meter for measuring a flow of fluid through a pipe, the optical flow meter comprising:
  - 5 (a) a Sagnac interferometer comprising a laser for generating a pair of beams, a driver for controlling said laser, a modulator coupled to said laser for modulating a phase of one of said pair of beams at a phase modulation frequency, a detector for receiving said pair of beams and for producing an electrical signal which oscillates with said phase modulation frequency, and a digital signal processor configured to receive said electrical signal and calculate a flow velocity from a phase difference between said pair of beams;
  - 15 (b) a pair of fibers coupled to the Sagnac interferometer to receive said pair of beams from said laser and return said pair of beams to said detector, said pair of fibers positioned to direct said pair of beams in opposite directions along a path through the flow of fluid at an acute angle to a direction of the flow, each of said pair of fibers comprising a tip positioned to direct one of said pair of beams towards a tip of the other of said pair of fibers and to receive a diffused beam from the tip of the other of said pair of fibers;
  - 20 (c) a pair of collecting optical systems, each of said pair of collecting optical systems positioned adjacent to the tip of one of said pair of fibers for collecting deflected light from said pair of beams; and,
  - 25 (d) a compensation module coupled to receive said deflected light from said collecting optical systems, said
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compensation module configured to estimate a total  
intensity of light received by the tips of said pair of fibers  
and generate a compensation signal representative of said  
total intensity of light received by the tips of said pair of  
fibers, and coupled to provide said compensation signal to  
5 said driver,  
whereby said driver controls said laser to vary an initial intensity  
of said pair of beams in response to said compensation signal such  
that said total intensity of light received by the tips of said pair of  
10 fibers remains constant.

12. A method of measuring a flow of fluid through a pipe, the method comprising:

- (a) generating a pair of beams of wave energy with a wave  
15 energy source;
- (b) modulating one of said pair of beams at a phase modulation  
frequency;
- (c) directing said pair of beams in opposite directions along an  
open optical path through the flow of fluid at an acute angle  
20 to a direction of the flow of fluid by means of a pair of  
fibers coupled to the wave energy source;
- (d) receiving said pair of beams after said pair of beams have  
passed through the flow of fluid by means of said pair of  
fibers;
- 25 (e) producing an electrical signal representative of a phase  
difference between said pair of beams received in step (d)  
by means of a detector coupled to said pair of fibers;
- (f) calculating a flow velocity from said phase difference  
between said pair of beams;

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- (g) collecting deflected wave energy from said pair of beams by means of a pair of collecting optical systems positioned at opposite ends of said open optical path;
- 5 (h) calculating a total intensity of said pair of beams received in step (d) based on the deflected wave energy collected in step (g) and providing said total intensity to a driver of said wave energy source; and,
- 10 (i) controlling said wave energy source with said driver to vary an initial intensity of said pair of beams in response to said total intensity such that said total intensity remains constant.

13. A method of measuring a flow of fluid through a pipe, the method comprising:

- 15 (a) calculating a flow velocity of said flow of fluid by means of a Sagnac interferometer comprising a laser controlled by a driver for generating a pair of beams, a pair of fibers coupled to said laser for directing said pair of beams in opposite directions along an open optical path through the flow of fluid at an acute angle to a direction of the flow of fluid and for receiving said pair of beams, and, a detector for measuring a phase difference between said pair of beams received by said pair of fibers;
- 20 (b) collecting deflected light from said pair of beams by means of a pair of collecting optical systems positioned at opposite ends of said open optical path;
- 25 (c) calculating a total intensity of said pair of beams received in step (a) based on the deflected light collected in step (a) and providing said total intensity to said driver of said laser; and,

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- (d) controlling said laser with said driver to vary an initial intensity of said pair of beams in response to said total intensity such that said total intensity remains constant.

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